axes of the orbits and the distance from the centre of gravity to the Sun.

Then the time taken by the light—

to pass from $S_1$ to the Sun will be $= \sigma - l_1 \cos n(T - \sigma)$

     ,,    ,,   $S_2$    ,,      ,,     $= \sigma + l_2 \cos n(T - \sigma)$

Consequently, putting $n(T - \sigma) = \theta$ :

$$\rho_1 = a_1 \,|\, \sin (\theta + n l_1 \cos \theta)\,|$$
$$\rho_2 = a_2 \,|\, \sin (\theta - n l_2 \cos \theta)\,|$$

where $\cos \theta$ is to be taken with its proper sign.

The quantities $l_1$ and $l_2$ being generally very slight, and since $a_1 l_2 = a_2 l_1$, we may put—

$$\rho = \rho_1 + \rho_2 = a \,|\, \sin\{\theta + n(l_1 - l_2) \cos \theta\}\,| \qquad . \qquad (9)$$

and consequently the correction for light-equation will be

$$\Delta m (l_1 - l_2) \cos \theta \qquad . \qquad . \qquad . \qquad (10)$$

Thus it would seem theoretically impossible to determine the absolute dimensions of the orbit in this manner. If this statement is correct, it follows that the numerical results of Dr. Roberts' paper cannot have the interpretation which is given to them.

*Specola Vaticana :* 1908 *March* 19.

---

### *Note to Father Stein's paper.* By Professor H. H. Turner, D.Sc., F.R.S.

THE following elementary geometrical considerations indicate the reasons why the light-equation fails to give us expected information about the orbit. They were mentioned at the meeting of the Society in communicating Father Stein's paper, and are added here as a note at the request of one of the Secretaries.

Consider the three cases—(*a*) when the mass of the bright body is so small as to be negligible; (*b*) when the mass of the dark body is negligible; (*c*) when the two bodies are of equal mass. And in each case let us suppose the orbit circular and in a plane passing through the line of sight, and that light takes a time 2T to cross the orbit.

(*a*) In the first case (fig. 1) the dark body is stationary at the centre O, and the bright body revolves round it, and is eclipsed at A, the Earth being in the direction of the arrow. The light which suffers eclipse reaches O at a time T *after* the actual eclipse.

(*b*) In the second case (fig. 2) the bright body is stationary at the centre O, and the dark body revolves round it and eclipses it when at B. But the light which suffers eclipse must leave O at a time T *before* the actual eclipse.

Hence, referring events to the time at which light leaves O (or more generally the line XOY), we see that in case (*a*) the apparent eclipse is *retarded* and in case (*b*) it is *accelerated* by an equal amount. What happens in case (*c*) when the bodies are equal?
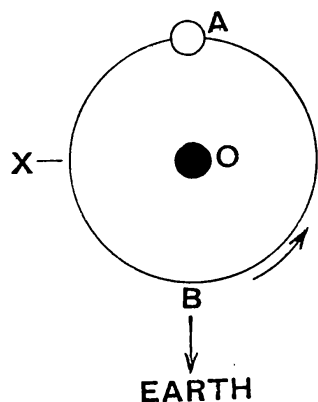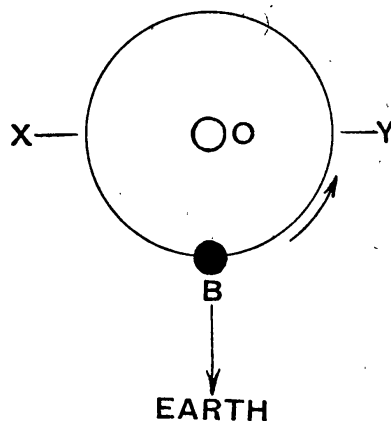


Fig. 1.



Fig. 2.

It is suggested that there is neither retardation nor acceleration, *i.e.* that the apparent eclipse takes place at the same time as the true eclipse, and this is actually the case. It was Professor Dyson who called attention to this case after reading Father Stein's paper at my request.
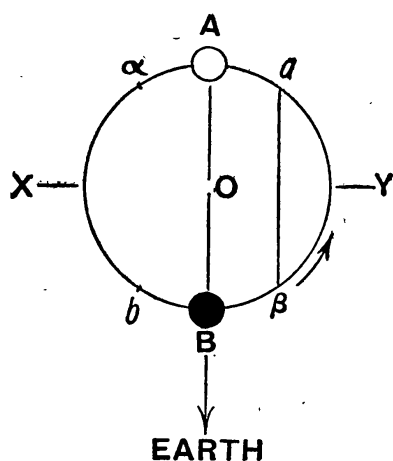


Fig. 3.

(*c*) When the masses are equal, they both revolve round O, their common C.G. The position for true eclipse is, bright body at A and dark at B; but the light which then leaves the bright body does not suffer eclipse, since when it reaches B the dark body will have moved away. Let *a*A, A*a*, *b*B, B*β* be four equal

small arcs described by either body in time T which light takes to cross the semi-orbit. Then the sequence of events is as follows:

|     | Bright Body. | Dark Body. | Eclipsed Light. |
|-----|--------------|------------|-----------------|
| (1) | At $\alpha$  | At $b$     | At $a$          |
| (2) | At A         | At B       | In XOY          |
| (3) | At $a$       | At $\beta$ | At $\beta$.     |

The eclipsed light must start before the bright body has reached A, and is eclipsed by the dark body after it has left B, so that the *position* for apparent eclipse is displaced from AB to $a\beta$. But we have no means of noting this displacement in space in the case of Algol variables. All we could note would be a change in epoch, and this is zero; for we see that the eclipsed light leaves XOY at the moment of true eclipse, when the bodies are at AB.

Hence, whatever the size of the orbit, when the masses are equal there will be no change in epoch of eclipse due to light-equation.

In other cases there will be a change of epoch,—a retardation if the dark body is larger, an acceleration if it is smaller. But the change will be small unless the masses are very unequal; and it will depend not only upon the size of the orbit, but on the ratio of the masses, which cannot be separately determined.

------

*Errata.*

In Professor Barnard's paper, page 357, line 27,

*for* Struve *read* Struve's,

In Mr. Baldwin's paper, page 369 (Table I.), the headings of the last four columns should be, respectively,

$d \log \sin^2 I$ ; Zenith dist. ; Extinction corr. ; $\Delta M$ ;

and the bracket over these columns omitted.